FINAL PLAN OF REMEDIAL ACTION

Millsboro TCE Groundwater Contamination Site
(a/k/a Millsboro Public Well TCE Site)
Millsboro, Delaware
DNREC Project No. DE-1361

December 2007

Delaware Department of Natural Resources and Environmental Control
Division of Air and Waste Management
Site Investigation & Restoration Branch
391 Lukens Drive
New Castle, Delaware 19720

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- This Final Plan of Remedial Action (Final Plan) presents the Department of Natural Resources and Environmental Control's (DNREC's) determination that: 1) the concentration of trichloroethylene (TCE) in the groundwater which impacts the public wells in the surficial aquifer in Millsboro exceeds the Maximum Contaminant Level for TCE in drinking water of 5 parts per billion; 2) the TCE concentrations in the groundwater present a risk to human health; and 3) the impacts to the groundwater require remediation.
- DNREC issued a public notice of the Proposed Plan for the Site on August 29, 2007 and opened a 20-day public comment period which closed on September 17, 2007. The Proposed Plan required: 1. Treatment of surface and subsurface soils at the TCE source area property via in-situ chemical oxidation injection to be protective of human health and the environment. 2. Treatment of groundwater at the TCE source area property and within the TCE groundwater contaminant plume via in-situ chemical oxidation and injection of zero valent iron to meet cleanup standards at the point(s) of exposure and within the plume. 3. Continued pumping and point-of-use treatment with GAC for the impacted water supply wells and any additional recovery wells installed within the TCE groundwater contaminant plume. 4. An operation and maintenance plan (O & M plan) for the site will be drafted to assure that any protective measures are properly maintained. 5. Additionally, environmental covenants will be placed on the source area property limiting its reuse to industrial or commercial use only.

- The Proposed Plan also included the location of additional information found on the DNREC web page and at the DNREC office on Lukens Drive in New Castle.

- The Department received written comments or questions from the public regarding the Proposed Plan. The Department's response to those comments is presented as Attachment A. Therefore, the Proposed Plan was modified to address those comments and the Plan has been adopted as the Final Plan (see attached).

- **Approval:** This Final Plan meets the requirements of the Hazardous Substance Cleanup Act.

Approved by:

James D. Werner, Director
Division of Air & Waste Management

2 JAN 2008
Date

Millsboro TCE Groundwater Contamination Site

What is the Millsboro TCE Groundwater Contamination Site?

The Site is a Hazardous Substance Cleanup Act (HSCA) site located in Millsboro, Delaware (Figure 1). The Site itself consists of a source area for trichloroethylene (TCE), located at the intersection of Wharton Street and S. DuPont Highway, a TCE recovery area, located at Church Street, and the impacted groundwater plume under the privately owned properties in between the source area and the two (2) public supply wells (Figure 2). The TCE source area is currently an open, vacant lot (Figure 3). The TCE source area was the former location of poultry vaccine manufacturing plant. The TCE recovery area currently consists of two (2) public water supply wells in the surficial aquifer in the Town of Millsboro (TOM)'s present well field.

Affected Tax Parcels include all or part of: 1-33-17.13-11.00; 1-33-17.13-12.00; 1-33-17.13-12.01; 1-33-17.13-14.00; 1-33-17.13-14.01; 1-33-17.13-15.00; 1-33-17.13-15.01; 1-33-17.13-15.02; 1-33-17.13-17.00; 1-33-17.13-150.00; 1-33-17.13-150.01; 1-33-17.13-151.00; 1-33-17.13-152.00; 1-33-17.13-154.01; 1-33-17.13-155.00.
Nearest major intersections: Wharton Street & S. DuPont Highway and Church Street & Sussex Alley.
Area: The area of known TCE impacted groundwater is approximately 1500 feet long by 300 feet wide.
Surrounding Property: Surrounding land use is primarily a mix of residential (houses, apartments and townhomes) and light commercial.
Site Utilities: These properties have city water and sewer service.
Nearest surface water body: Millsboro Pond, 3,000 ft. north from the source area. The Site is not within the 100-year flood plain. It is flat.
Groundwater: Shallow groundwater at the Site flows to the north towards Millsboro Pond. The City of Millsboro water supply wells are located within the recovery area of the Site.

What happened at the Millsboro TCE Groundwater Contamination Site?

The TCE source area was used for the manufacturing of poultry vaccines between 1952 and August 1999. Previous owners and/or operators of the source area property included: Delaware Poultry Laboratories, Inc., Sterwin Laboratories, Mallinckrodt Veterinary, Inc. and Schering-Plough Animal Health Corporation. The poultry vaccine manufacturing building was demolished in December 1999. The operation and use of the TCE source area as a poultry vaccine manufacturing plant resulted in the release of hazardous substances, including TCE, into the soil and groundwater.

What is the environmental problem at the Millsboro TCE Groundwater Contamination Site?

Due to the operation and use of the TCE source area as a poultry vaccine manufacturing facility, surface and subsurface soils have become contaminated with TCE, a man-made chlorinated volatile organic compound. The groundwater underneath the source area, and within the plume emanating to the north, has also been contaminated with TCE at levels exceeding the Maximum Contaminant Level (MCL) for TCE in drinking water of 5 parts per billion (ppb). The groundwater is currently being used for drinking water by the TOM and is currently being treated with granulated activated carbon (GAC) to meet the drinking water standard in order to be protective of human health.

The TCE source area was subject to the removal of several underground storage tanks (USTs) and aboveground tanks (ASTs) containing fuel oil, propane and diesel between the late 1980's and late 1990's. A Phase I and a Phase II Investigation was conducted on properties, which included the TCE source area, by Metcalf & Eddy in 1997. The investigation included soil borings, and soil and ground water sampling of the TCE source area. This investigation showed that the only adverse environmental impact on the property at the time was from the release of petroleum hydrocarbons from a UST. A hydrogeologic investigation of former UST locations on several properties, which included the TCE source area, was then conducted by Environmental Resources Management in 1998. Additional groundwater investigation and groundwater monitoring were also conducted at the property between 1998 and 2001 leading to the issuance of a No Further Action (NFA) letter from the Tank Management Branch (TMB) in 2001.

During the week of October 17, 2005, routine Division of Public Health Office (DPH) Office of Drinking Water (ODW) sampling in the Dagsboro area identified TCE contamination in a new connection to the TOMs supply wells. The DPH issued a Public Notice requiring the contaminated supply wells to be taken offline and the use of supplied water by residents of Millsboro and Dagsboro. GAC treatment systems were installed on the impacted Millsboro water supply wells in November 2005 and the Public Notice was lifted by the DPH in late November and early December 2005.

In December 2005, DNREC's consultant, EA Engineering, Inc. (EA), initiated a Site Investigation (SI) to determine the source of the TCE contamination in the TOM supply wells. The sampling program began with the collection of groundwater grab samples from multiple depths at locations on the TOMs Water Plant property (Figure 2), which is located on Church Street. Groundwater grab samples were then collected from multiple depths at sample locations to the east, west and south of the impacted water supply wells in an upgradient direction. An exceptionally high concentration of TCE was found in the shallow groundwater sample from a property that was later identified as the source area. A geophysical survey was conducted on that property and several anomalies were identified, investigated and subsequently removed. Two (2) USTs that may have served as dry wells and/or septic systems were found on the TCE source area property with very high concentrations of TCE in their sludge as well as in the surrounding soils. Approximately 209 tons of contaminated media including these tanks were subsequently removed as part of an interim action. Additional groundwater samples were also collected in the vicinity of Wharton Street and DuPont Highway to further define the source of the TCE groundwater contamination.

In August 2006, four (4) indoor air samples were collected by EA from the residence adjacent to the TCE source area property to determine if volatilization of TCE from groundwater would pose an unacceptable human health risk to the occupants. There was no TCE or any degradation products detected in any of the indoor air samples collected.

As a result of the SI sampling, DNREC determined that surface and subsurface soils in the source area were contaminated with TCE. Unless the source area contamination is remediated, it could pose an unacceptable human health risk to people residing at the site or to construction workers who would perform redevelopment activities at the TCE source area property. The groundwater flowing beneath the TCE source area property towards the TOMs supply wells is contaminated with TCE and poses an unacceptable human health risk to people drinking the water unless it is remediated.

What does the owner want to do at the Millsboro TCE Groundwater Contamination Site?

The property owner, H. Dennis Lasher, was planning to develop the TCE source area property into a commercial business site after remediation of the most heavily contaminated soils has been completed, necessary for safe redevelopment of the site.

The plans for site redevelopment, following the environmental cleanup, will most likely include debris removal, re-grading, and then construction of the new site structures and landscaping.

What clean-up actions have been taken at the former Millsboro TCE Groundwater Contamination Site?

In order to remove the sources of contamination and mitigate any potential off-site migration of contamination, as well as reduce on-site hazards, a series of interim actions have taken place at the site. In June 2006, in order to prevent further groundwater degradation, surface and subsurface soils in the vicinity of the two (2) USTs containing TCE sludge at the source area property were excavated and properly disposed of off-site. In addition, a septic tank system and all subsurface piping encountered by DNREC during the investigation of the source area property were also excavated and properly disposed of off-site.

What additional clean-up actions are needed at the former Millsboro TCE Groundwater Contamination Site?

A final Focused Feasibility Study (FFS) for groundwater remediation was approved by DNREC in May 2007. An addendum to the FSS to include soil removal was approved by DNREC in July 2007. Based on comments to the Proposed Plan received by DNREC, DNREC's clean-up plans for the Site include: treatment and/or removal of soil and groundwater at the TCE source area property and within the associated TCE groundwater plume; the possible formation of a permeable reactive or other type of barrier; continued pumping and point-of-use treatment with

GAC for the impacted water supply wells; additional investigation and site characterization; the installation of monitoring wells and if necessary, additional recovery wells within the TCE groundwater plume, and land-use controls.

The following cleanup actions are proposed for the Millsboro TCE groundwater contamination site:

1. Treatment and/or removal of surface and subsurface soils at the TCE source area property by methods to be determined by additional evaluations, bench scale and/or pilot scale testing during the remedial design to be protective of human health and the environment.
2. Treatment and/or removal of groundwater at the TCE source area property and possibly within the TCE groundwater contaminant plume by methods to be determined by additional evaluations, bench scale and/or pilot scale testing during the remedial design to meet cleanup standards at the point(s) of exposure and within the plume in order to restore the aquifer to potability in a timely manner.
3. Continued pumping and point-of-use treatment with GAC for the impacted water supply wells..
4. An operation and maintenance plan (O & M plan) for the site will be drafted and implemented to assure that any protective measures that are constructed are properly maintained.
5. Additionally, environmental covenants will be placed on the source area property limiting its reuse to industrial or commercial use only.

What are the long term plans for the Millsboro TCE Groundwater Contamination site after the cleanup?

The long term plans, or requirements by DNREC for the TCE source area property may include commercial redevelopment. DNREC will require an environmental covenant to restrict the property to industrial or commercial reuse. Additionally, an O&M plan will be prepared and submitted to DNREC for approval in order to maintain the integrity of the remedy at the site and the safety and future site redevelopment.. All costs associated with the investigation and remediation of the site to date have been have been paid by DNREC from the HSCA Fund. DNREC will pursue cost recovery for all expenses from all potentially responsible parties (PRPs).

DNREC plans to issue a Certificate of Completion of Remedy for the site after the completion of clean-up, the redevelopment of the property, and the implementation of the uniform environmental covenants at the site.

How can I find additional information or comment on the Final Plan?

The complete file on the site including the Proposed Plan, and the Site Investigation/Focused Feasibility Study is available at the DNREC office, 391 Lukens Drive in New Castle. Most documents are also found on:

http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/

RCA:vdc; RCA07084.doc; DE 1361 II B 9

Figure 1: Millsboro TCE Groundwater Contamination Site Location Map

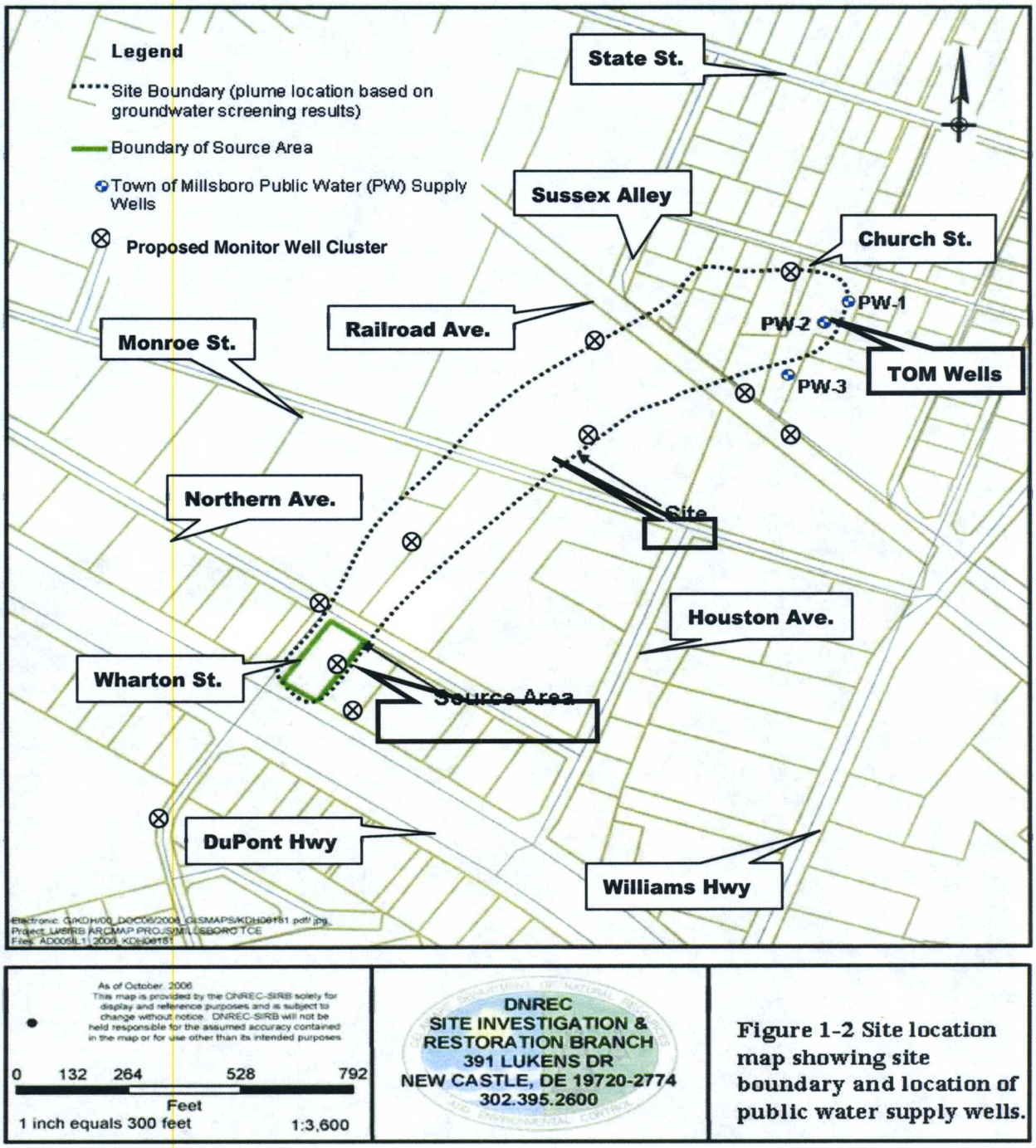

Figure 2. Site Location Map showing site boundary based on groundwater screening results, source area, location of public supply wells and proposed monitoring well clusters.

Figure 3. View of Millsboro's Water Tower from the TCE source area at Wharton Street and 225 W. DuPont Highway.

Glossary of Terms
Used in this Final Plan

Brownfield	Property that is vacant or underutilized because of the perception or presence of an environmental problem
Certificate of Completion of Remedy (COCR)	Upon completion of all tasks (except operations and maintenance) specified in the Final Plan, the person cleaning up a site, or the owner of a site, may apply for a COCR. When issued, a COCR is recorded on the county tax records for a property, identifying the property as having been cleaned up as specified in the Final Plan. A COCR may include conditions or restrictions. A checklist of the requirements for a COCR is at *http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/misc%5CJGC07004.pdf*
Contaminant of Concern (COC)	These are potentially harmful substances at concentrations above acceptable levels (e.g. metals and PAH).
Contamination	The introduction of harmful or hazardous matter into the environment
Exposure	Contact with a substance through inhalation, ingestion, or direct contact with the skin. Exposure may be short term (acute) or long term (chronic).
Environment	The navigable waters, the waters of the contiguous zone, ocean waters, and any other surface water, groundwater, drinking water supply, land surface or subsurface strata or ambient air within the State.
Facility Evaluation (FE)	If the initial investigation indicates a release or imminent threat of release, DNREC conducts an FE to assess the related risk. This may consist of a review of general facility and existing information and/or a field investigation, including sampling of soil, air, groundwater, surface water, sediments, and animals or plants as appropriate. The scope is flexible and depends on the specific conditions of the facility.
Feasibility Study (FS)	A study undertaken to develop, screen and evaluate options for remedial action, performed after or in combination with a Remedial Investigation (RI).
Final Plan of Remedial Action ("Final Plan" *or* **FPRA)**	DNREC's plan for cleaning up a hazardous site after it has been reviewed by the public; the written determination by the Secretary, of appropriate action for remediation of a release at or from a facility to protect public health, welfare, or the environment.
Groundwater	Water below the land surface in the zone of saturation.
Groundwater Management Zone (GMZ)	A geographical area where DNREC restricts drilling for ground water because it is or may be contaminated.

Hazardous Substance Cleanup Act (HSCA)	7 *Delaware Code*, Chapter 91. Found at http://www.delcode.state.de.us/title7/c091/index.htm#P-1_0 In 1990, Delaware enacted HSCA to deal with potentially harmful sites in the state that will not receive the attention of the federal government. In July of 1995, HSCA was amended to encourage voluntary cleanup of sites and restoration of "brownfields."
Interim Action *or* **Interim Response Activity**	The containment, cleanup, or removal of a release or imminent threat of release of hazardous substances from a facility, or the taking of other actions, prior to the selection of a remedial action, as may be necessary to prevent, minimize, or mitigate threat to public health, welfare, or the environment. If DNREC determines that an interim measure is necessary, it may require interim response activities to be conducted. These activities may occur any time during the cleanup process.
No Further Action (NFA)	A No Further Action decision can be issued at the end of an investigation or the completion of the remedy. NFA means that no known danger exists at the site.
Operations & Maintenance (O&M)	The activities necessary to provide for continued effectiveness and integrity of a remedial action after it is completed. O&M includes all activities needed to ensure effective operation of the remedy under both normal conditions and emergencies. Post-cleanup compliance monitoring (regular testing to determine if the prescribed cleanup levels have been met and if the treated effluent or emission meets discharge requirements) is often included under O&M.
Owner or Operator	(a) Any person owning or operating a facility. (b) Any person who previously owned, operated, or otherwise controlled activities at a facility. (c) The term "owner or operator" does not include an agency of the State or unit of local government that acquired title or control of the facility involuntarily through bankruptcy, tax delinquency, abandonment or other circumstances. (d) The term "control" does not include regulation of the activity by a federal, state or local government agency. (e) The term "owner or operator" does not include a person, who, without participating in the management of a facility, holds indicia of ownership primarily to protect his security interest in the facility.
Potentially Responsible Party (PRP)	Any person identified pursuantto Section 9105 (a) (1) through (6) of the HSCA Regulations as a person liable with respect to a facility.

Proposed Plan of Remedial Action ("Proposed Plan" *or* PPRA)	A plan for cleaning up a hazardous site submitted by DNREC for public review and comments; a detailed plan describing cleanup actions and related information for the containment or permanent removal and disposal of hazardous substances from a facility, or other measures to protect public health, welfare, and the environment.
Regulations	As used under HSCA, the Delaware *Regulations Governing Hazardous Substance Cleanup*, found at http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/DOCS/PDFS/Misc/fdb99085.pdf
Remedial Action (RA)	The containment, contaminant mass or toxicity reduction, isolation, treatment, removal, cleanup, or monitoring of hazardous substances released into the environment, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate harm or risk of harm to the public health, welfare, or the environment which may result from a release or an imminent threat of a release of hazardous substances. After the remedy selected in the Final Plan has been designed and specified, its implementation becomes the RA. The RA should follow the approved design and achieve all performance measures.
Site Investigation and Restoration Branch (SIRB)	The branch within DNREC's Division of Air and Waste Management (DAWM) which carries out HSCA and the Regulations, overseeing cleanup and restoration of hazardous substance sites..
Surface Water	The waters of the State of Delaware, occurring on the surface of the earth.
Uniform Environmental Covenants Act (UECA)	A standardized form of a land use restriction that is recorded on the deed and runs with the land.

What is a *Final Plan?*

A Proposed Plan of Remedial Action (Proposed Plan) is a summary of how DNREC plans to clean up a contaminated site. A Final Plan of Remedial Action (Final Plan) is the adoption of the Proposed Plan, after all comments made by the public within the comment period of twenty days have been considered and addressed by DNREC.

The Delaware State Legislature passed the Hazardous Substance Cleanup Act (HSCA) in 1990. The Legislature made sure that members of the public would be informed about environmental problems in their own neighborhoods and have a chance to express their opinion concerning the clean up of those environmental problems before DNREC takes action.

After DNREC studies a site, it summarizes the problems there and proposes one or more possible solutions in a Proposed Plan. The Proposed Plan contains enough information to allow lay persons to understand the site. More detailed information can be found in the reports and documents approved by DNREC. All of the documents and reports created by DNREC or consultants during the course of the investigation of the site are available to the public at the offices of DNREC-SIRB or at DNREC's website:

http://www.dnrec.state.de.us/dnrec2000/Divisions/AWM/sirb/sitefiles.asp .

DNREC issues the Proposed Plan by advertising it in at least one newspaper in the county where the site is located. The legal notices for the Proposed Plans and the Final Plans usually run on Wednesdays or Sundays in the legal classified section of the News Journal and/or the Delaware State News. The public comment period begins on the day (Wednesday), or the day after (Sunday) the newspaper publishes the legal notice for the Proposed Plan.

DNREC frequently holds public meetings during the comment period. Those meetings are usually held near the site in the evening. Citizens can request a public meeting if DNREC did not already schedule one.

Comments are collected at the public meetings, by phone or in writing. DNREC considers all comments and questions from the public before the Proposed Plan is finalized and adopted as a Final Plan.

ATTACHMENT 1:

Millsboro TCE Groundwater Contamination Site
Proposed Plan of Remedial Action
Department Responsiveness Summary
For Public Comments

Comments from Schering-Plough Corporation: A comment letter was received by email from Schering Plough Corporation, dated September 14, 2007.

Comment: The Proposed Plan issued by DNREC has not been preceded by the issuance of a report of the findings of DNREC's investigation (i.e., a Remedial Investigation Report) in accordance with Subsection 8.3 of Delaware Regulations Governing Hazardous Substance Cleanup (DNREC 1999, amended 2002). In the absence of a summary report, it is extremely difficult for members of the public to form any opinion regarding the procedures, methods, or findings of the investigation which formed the foundation underlying the Proposed Plan of Remedial Action (PPRA).

Response: In accordance with Subsection 8.3 (2) of Delaware Regulations Governing Hazardous Substance Cleanup (DNREC 1999, amended 2002) (Regulations), the Department has determined that the existing information collected during EA's SI as presented in the Focused Feasibility Study (FSS) constitutes the equivalent of a remedial investigation.

Comment: A Risk Assessment as required by Subsection 8.3 (5) has not been conducted to quantify the level of risk posed to receptors of contamination and/or to document that further remedial action is necessary and warranted by an exceedance of the allowable level of risk of 10E-5 cancer risk or a hazard index of one per Subsection 9.2 – "Groundwater Cleanup Levels" of the regulations.

Response: TCE is present in groundwater in concentrations at 100 to 20,000 times greater than the regulatory standard. This clearly results in unacceptable risk that far exceeds 10E-5 cancer risk; therefore, no formal risk assessment was performed.

Comment: Remedial Action Objectives have not been developed by DNREC to state the qualitative and quantitative objectives of further remedial actions at the property as required per Subsection 8.4 of the Regulations.

Response: DNREC's Remedial Action Objectives have been included in Section 1.3 of the Final Focused Feasibility Study, dated February 16, 2007.

Comment: The DNREC tasked a consultant to develop a Feasibility Study (FS), issued in Final version on February 16, 2007:

a) The FS was written in the absence of the development of Remedial Action Objectives, which is in contrast to the Subsection 8.4 of the Regulations.

b) We believe the FS is flawed because it ignored the extensive body of post-treatment groundwater data that show that the remedial actions already conducted have reduced the TCE concentration in the water entering the drinking water system to a level below HSCA risk thresholds and below MCLs. As a result, the water meets the Cleanup Criteria of Subsection 9.2 of the Regulations, and as such, further extensive remedial actions may not be warranted.

Response to a): DNREC's Remedial Action Objectives have been included in Section 1.3 of the Final Focused Feasibility Study.

Response to b): Prior to treatment, the groundwater does not meet the MCLs. Under Subsections 9.2 (1) and (2) of the Regulations, the Department is charged with protecting the highest beneficial use of groundwater, which is drinking water. In addition, the current activities/actions do not attain all ARARs, and may present potential risk to other receptors.

Comment: The DNREC issued a letter dated May 10, 2007 stating "...DNREC SIRB agrees with the recommendations made by EA to adopt Alternative 3 as the preferred remedial action for the groundwater at the site". The selection of the Final Remedy (Alternative 3 from the FS) was performed prior to the start of the public comment period (August 29 to September 17, 2007) and was formed without "due consideration of any public comments that may be received", as required by HSCA (Ch.91, Section 9107- Remedies (e)(3).

Response: DNREC's recommendations to adopt Alternative 3 as the preferred remedial action for the groundwater at the site were presented in the Proposed Plan for public comment in accordance with Subsection 8.7 of the Regulations.

Comment: In July 2006, DNREC preformed what was described as an Interim Soil Removal Action (IRA) to remove soil and underground tanks. By that time, a Granulated Activated Carbon (GAC) system had already been installed (installed in November 2005) at the Town wells which provided protection against an immediate threat to the public. The IRA was performed without a Public Notice as required by HSCA 9107(a) (1) to allow interested parties to comment on or observe the IRA.

Response: Under Subsections 1.2 (k) and 8.2 (1) of the Regulations, the Department may conduct an interim response activity at any time prior to the selection of the final remedy when the Department determines that there is a release or an imminent threat of a release. Interim response actions taken under these subsections are not subject to public comment requirements. The Department determined that the presence of percentage levels of TCE in the soil at the

source area property constituted an imminent threat of a release and that the interim response action would not be inconsistent with or interfere with a final plan.

Comments specific to the Proposed Plan of Remedial Action (PPRA):

Comment: The PPRA proposes multiple remedial actions to reduce contamination. These include the injection of oxidation chemicals at the source to reduce the source materials, the injection of zero valent iron down gradient of the source and the continued operation of the GAC system at the Town wells.

These multiple actions appear to be redundant in some respects and performance of all of them simultaneously may not necessarily reduce the amount of time it will take to complete the remediation or create any positive benefits to reduce the risk to sensitive receptors.

Response: As presented on page 2-36 of the FFS, the proposed remedial alternatives incorporate deliberate redundancies using a combination of different, but equally effective treatment technologies to treat the source area soil and groundwater, as well as the groundwater plume prior to point of use treatment will expedite the timeframe required to restore the aquifer to its most beneficial use, which is drinking water.

Remedial actions at the source reduce area the overall flux of contamination that leaves the source area, thus reducing the number of pore volumes of groundwater required to flush contaminants from the intermediate or wellhead protection zones. The objective is to treat as much of the contaminated aquifer using *in situ* technologies as possible and not allowing contaminated groundwater to migrate over large distances to be captured and treated at the supply wells, thus reducing overall remedial timeframes. The longer TCE is allowed to reside *in situ* and untreated it will increase the probability that TCE may dechlorinate to a more toxic and mobile vinyl chloride (VC), which is not effectively treated by GAC.

Comment: In July 2006, a source removal was performed, which eliminated source materials from above the ground water table. In November 2005 a GAC system was installed on the Town's well discharges. The GAC system has been very effective in removing TCE from the well water to levels below the MCLs in the drinking water supply. The combination of these two actions has significantly reduced the mass of TCE contamination in a short amount of time. Rough estimation of TCE removal based on the pumping rate of the wells and the concentration of TCE removed by the GAC systems indicate that as much as 50% of the original TCE may have already been removed through the GAC system alone, since the system was installed.

Response: The GAC system that has been installed on the Town's wells has been effective at treating the ground water to drinking water standards. While it may offer point-of-use protection from TCE, it may not be as effective at treating some of the degradation products of TCE such as VC should they reach the wells. Pulling TCE across the 1500 foot length of the plume to be treated at the wellhead by GAC is not an efficient way to remediate the contaminant as it will require large numbers of pore volumes of water to be recovered and treated before the aquifer is restored accelerate to it most beneficial use. Therefore, GAC alone without additional groundwater treatment won't achieve aquifer restoration in a timely manner that is acceptable to DNREC. The total recoverable mass of TCE other than the dissolved-phase fraction has not been

estimated because of the likelihood of DNAPL being present in the source area, so that any estimate of the original mass of TCE in the ground water is a very rough one at best.

Comment: It is certainly unclear whether the performance of chemical oxidation injections at the source or injections of negative valent iron down gradient of the source will significantly improve the remediation beyond what the GAC system is providing or whether they will significantly reduce the time frame of the remediation. In fact the injections may even be detrimental in remediating the contamination.

The application of zero valent iron has been problematic at many remediation sites. It has been known to lose its reactivity as a result of passivation of the exterior of the particles. This effectively eliminates its ability to decompose TCE or other chlorinated hydrocarbons. In other cases, the iron has fouled to such an extent that it has hindered the flow of groundwater through the material. This could potentially divert contaminated groundwater to areas that are not presently affected.

Response: Many of the issues cited above are related to traditional excavated trenches with a mixture of sand and iron filings. Passivation and reduction in porosity have been observed in these typical "iron wall" designs. The planned approach for Millsboro is to use a process whereby zero-valent iron powder is injected by direct-push methods into the formation as slurry or as a dry material with nitrogen gas or compressed air used as the carrier fluid. So it is not an "iron wall" per se, but a ZVI Impregnated treatment zone. pH increase is typically much less than that observed in a “iron wall” with no evidence of the iron losing its reactivity over a long term. Fine powder by nature will have a larger surface area for reaction with contaminants. A 0.05% to 1.5% iron-to-soil ratio by mass translates to an even lower iron-to-soil ratio by volume due to the large difference in particle density. Therefore the change to the permeability of the aquifer is negligible. The life cycle of the ZVI wall is expected to be between 5-7 years. If needed a second injection over a smaller area or at a lower ZVI concentration could extend the wall life for several more years (cost was included in O&M for second ZVI injection). Particulars on wall length, exact location, and any other beneficial geochemical enhancements to extend and optimize treatment would be conducted during the engineering design phase.

Comment: The injection of oxidizing chemicals also can leave residual chemicals in the groundwater such as permanganates and iron that could affect the quality of the groundwater. Currently the GAC system is effectively removing the TCE but would not be effective in dealing with residual metal components in the groundwater.

Response: Chelated iron is injected to produce an approximate iron concentration of 50 to 100 ppm in the groundwater for the duration of the chemical reaction. However, as chelates are consumed by hydrogen peroxide, the iron is liberated and slowly precipitates as corresponding oxyhydroxides. Although temporary increases in iron may be noted, the iron levels return to near background levels in a matter of months. Transportation of iron from the source area to the wells is nearly impossible because iron tends to be adsorbed to soil. Without chelates, iron won't even travel a short distance without getting adsorbed to the soil and the oxidant will consume the chelates injected to gradually liberate the iron. As far as the oxidants are concerned, hydrogen peroxide will break down to oxygen and water.

Comments from Bryan Cave LLP on behalf Mallinckrodt Veterinary, Inc.: A comment letter was received by email from Bryan Cave LLP on behalf of Mallinckrodt Veterinary, Inc., dated September 17, 2007.

Comment: FFS Failed To Adequately Analyze a More Robust Limited Action Alternative Adding Treatment at the Lasher Property to Continued Pumping and Treatment of the Public Water Supply Wells.

It is apparent that the PPRA is based on the Final Focused Feasibility Study for Millsboro Public Well TCE Site (DE-1361) dated February 16, 2007 (the "FFS"). The FFS analyzed six alternative remedial options including No Further Action. FFS at 2-33 to 2-34. In discussing the No Further Action Alternative, the FFS identified a seventh alternative called the "Limited Action Alternative". FFS at 2-35. The FFS defined the "Limited Action Alternative" as the current status quo consisting of GAC treatment and monitoring. Id. The FFS acknowledged that the Limited Action Alternative "for the short term ... would be protective of the public and may also provide prevention of further dissolved plume migration to the north ..." Id. However, the FFS rejected further consideration of the Limited Action Alternative noting that: (a) there has not been enough remediation at the Lasher Property "to the degree" that it "can be left alone"; (b) "there are no current land use restrictions in place"; and (c) "it is not prudent to continue to pull contamination from the source area and essentially spread higher levels of dissolved-phase contamination throughout the contaminant plume." Id. As a result, the Limited Action Alternative did not receive the level of evaluation provided to the six alternatives more fully considered in the FFS.

The above reasons for rejecting the Limited Action Alternative suggest that there was at least one other alternative that should have received at least the same level of consideration as the six alternatives set forth in the FFS. First, each of the six fully considered alternatives includes implementation of "land use controls". Thus, citing the current lack of land use controls as the basis for rejecting consideration of a remedial alternative is inconsistent with the remainder of the FFS which anticipates the future implementation of land use controls.

Response: The "status quo" or limited action was presented as what is currently ongoing at the site. It was summarily dismissed without a detailed evaluation based precisely on the reasons cited in the Cave letter. Specifically, no current land use restrictions are in-place for the property which presents a potential future risk to receptors and as such does not meet the threshold criteria of protecting human health or the environment. Inherently, all other alternatives that were evaluated, except "No Action", included land use restrictions for consistency.

Comment: Second, the need to address contamination at the Lasher Property so that the public wells would not continue to pull contamination from the source property could have been addressed by including treatment at the Lasher Property thereby creating an "Enhanced Limited Action Alternative" that would not be subject to the same reasons for summary rejection as the Limited Action Alternative summarized in the FFS. The Enhanced Limited Action Alternative would consist of source control measures at the Lasher Property via in situ chemical

oxidation, ongoing use of the public wells with GAC Treatment and institution of appropriate land use controls and ongoing monitoring. Because it would address the contamination remaining at the Lasher property, this Enhanced Limited Action Alternative would not be subject to the same basis for summary dismissal as the Limited Action Alternative was in the FFS.

Response: An Enhanced Limited Action Alternative was not proposed based on the rationale presented on page 2-36, specifically the proposed alternatives that were evaluated in detail incorporated deliberate redundancies using a combination of different, but equally effective treatment modalities. The use of an intermediate plume treatment technology (e.g., ZVI barrier) is intended to achieve the following two objectives that an alternative not including an intermediate treatment technology (e.g., Enhanced Limited Action) will not achieve.

1. The ZVI barrier will expedite the remedial timeframe by allowing contaminated intermediate plume groundwater and dissolved-phase contaminants upgradient of the barrier to pass through and be treated by the barrier as opposed to permitting the contaminants to be pulled across the entire length of the plume until it reaches the supply wells. The longer TCE is allowed to reside *in situ* and untreated will increase the probability that TCE will dechlorinate to a more toxic and mobile Vinyl Chloride (VC). VC is not effectively treated by GAC.

2. The ZVI barrier configuration will reduce levels of TCE and other degradation daughter products (e.g., DCE and VC) before they enter the well-head zone. This is considered to be important because the source area treatment may not initially achieve a dissolved-phase TCE reduction to regulatory standards (i.e., MCLs). Moreover, dissolved-phase TCE contamination is present in the intermediate zone that is significantly above regulatory standards and is most efficiently addressed *in situ* using a passive treatment technology such as ZVI.

Comment: In addition, other comments in the FFS suggest that further evaluation of the Enhanced Limited Action Alternative is appropriate. For example, the FFS states that "...the levels of TCE in supply well samples has stabilized over the past several months ..." FFS at 1-13. The FFS expresses concern about increasing TCE levels at the supply wells if the contamination at the Lasher Property is not further addressed. Id. But the Enhanced Limited Action Alternative addresses this concern by addressing the contamination at the Lasher property.

Response: Source treatment alone may not fully reduce the levels of TCE throughout the aquifer sufficiently to meet drinking water standards in a timely manner. Furthermore, it is not only TCE, but the likely eventual formation and transport of VC throughout further reaches of the plume where it may be captured by the supply wells. VC is not effectively treated by GAC.

Comment: The Enhanced Limited Action Alternative addresses the human health risk presented by potential drinking water as it contemplates land use controls against direct use of the water and ongoing treatment to the extent that the public wells are used to provide drinking water. Specifically, the chemical oxidation addresses the contamination on the Lasher property and the use of the public wells with GAC treatment eliminates concern about exposure at the point of use. Thus, the Enhanced Limited Action Alternative would be protective against risk of exposure via the drinking water pathway without the need for zero valent iron (ZVI) as contemplated by the remedial alternative put forth in the PPRA. The indoor air quality data

showing the lack of TCE in the adjacent residence (see next paragraph) provides further support for a more detailed consideration of a remedy that does not include ZVI as a component but still addresses the relevant risks.

Response: The Department must also consider remedy of the groundwater to regulatory standards (ARARs), which is also a threshold criterion for alternative analysis. The use of an intermediate plume barrier configuration, while offering the benefits of reducing remnant dissolved-phase contaminant levels before entering the well-head zone, protecting against VC formation, and accelerating plume remediation timeframe, works passively as groundwater naturally flows through it with or without pumping of the supply wells.

Comment: Similarly, because it would address contamination at the site through remediation and implementation of land use controls, the Enhanced Limited Action Alternative would also address the human health risk to potential future residents at the site and construction workers. Construction workers can be protected by development of a plan governing construction activities at the site. Also, to the extent contamination is 'left in place', buildings can be designed to avoid accumulation of volatiles inside. In this regard, it is worth noting that the results of indoor air quality samples at the adjacent residence found "...no TCE or its degradation products in any of the indoor air samples collected." PPRA at 5. Mallinckrodt respectfully submits that, prior to issuance of a final Plan of Remedial Action, the Enhanced Limited Action Alternative should receive full consideration similar to that received by the other six alternatives prior to the agency making a final decision on the PPRA.

Response: Source treatment alone or with the implementation of land use controls may not fully reduce the levels of TCE throughout the aquifer sufficiently to meet drinking water standards in a timely manner. Furthermore, it is not only TCE, but the likely eventual formation and transport of VC throughout further reaches of the plume where it may be captured by the supply wells. VC is not effectively treated by GAC.

Comment: For example, the sampling data in Appendix A of the FFS and the corresponding site maps do not clearly demonstrate that the contamination at the Millsboro public wells results directly from the Lasher Property.

Response: DNREC is confident that the groundwater and soil sampling data in Appendix A of the FFS and the corresponding site maps clearly demonstrate that the contamination at the Millsboro public wells results directly from the Lasher Property.

Comments from Richards, Layton & Finger on behalf H. Dennis Lasher: A comment letter was received by facsimile from Richards, Layton and Finger on behalf of H. Dennis Lasher, dated September 17, 2007.

Comment: The Proposed Plan discusses certain long term plans relating to the Site after cleanup by stating that "current and future owners of the property will be responsible for the implementation of all aspects and costs of the approved remedy..."

Response: Under HSCA § 9105 (a) (1), the Standard of liability any person who owned or operated the Site at any time is liable. DNREC will hold the potentially responsible persons (PRPs) in accordance with Section 6 of the Regulations responsible for the implementation of all aspects and costs of the approved remedy, including all requirements of the final plan of remedial action, the DNREC approved contaminated materials management plan and O&M plan, and the adherence to the requirements and conditions established in the uniform environmental covenants for the site.
